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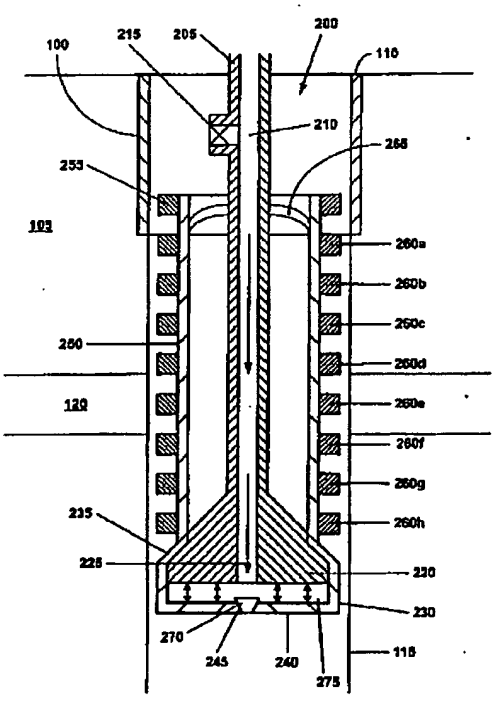
(54) Title: LINER HANGER WITH STANDOFFS



(57) Abstract: An apparatus and method for forming or repairing a wellbore casing (110) by radially expanding a tubular liner (250) having standoffs (260a-h).

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LINER HANGER WITH STANDOFFS

Background of the Invention

This invention relates generally to wellbore casings, and in particular to wellbore casings that are formed using expandable tubing.

Conventionally, when a wellbore is created, a number of casings are installed in the borehole to prevent collapse of the borehole wall and to prevent undesired outflow of drilling fluid into the formation or inflow of fluid from the formation into the borehole. The borehole is drilled in intervals whereby a casing which is to be installed in a lower borehole interval is lowered through a previously installed casing of an upper borehole interval. As a consequence of this procedure the casing of the lower interval is of smaller diameter than the casing of the upper interval. Thus, the casings are in a nested arrangement with casing diameters decreasing in downward direction. Cement annuli are provided between the outer surfaces of the casings and the borehole wall to seal the casings from the borehole wall. As a consequence of this nested arrangement a relatively large borehole diameter is required at the upper part of the wellbore. Such a large borehole diameter involves increased costs due to heavy casing handling equipment, large drill bits and increased volumes of drilling fluid and drill cuttings. Moreover, increased drilling rig time is involved due to required cement pumping, cement hardening, required equipment changes due to large variations in hole diameters drilled in the course of the well, and the large volume of cuttings drilled and removed.

The present invention is directed to overcoming one or more of the limitations of the existing procedures for forming wellbores and wellheads.

Summary of the Invention

The present invention particularly concerns, in all its various aspects, coupling a tubular liner to a wellbore casing of a cased section of a wellbore that traverses a subterranean formation, wherein an uncased section of the wellbore traverses a porous subterranean zone and the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone.

According to a first aspect, the invention provides a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising: positioning a

solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing; during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore; radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

The method of this aspect may further comprise, during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the uncased section of the wellbore; and preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

Also according to the first aspect the invention provides a system for coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising: means for positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing; means for during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore; means for radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and means for preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

The system of this aspect may further comprise means for during the positioning of

the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the uncased section of the wellbore; and means for preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

Further according to the first aspect the invention provides apparatus for coupling a tubular liner to the wellbore casing, comprising: a tubular support member defining a first internal passage; an expansion cone coupled to the tubular support member defining a second internal passage fluidicly coupled to the first internal passage; a tubular expansion cone launcher movably coupled to and mating with the expansion cone; a solid tubular liner coupled to an end of the tubular expansion cone launcher; and a shoe coupled to another end of the tubular expansion cone launcher including a valveable passage; means for during a positioning of the solid tubular liner within the wellbore, preventing a portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the wellbore; and means for preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the wellbore during a radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

The apparatus of this aspect may further comprise means for during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the wellbore; and means for preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

According to a second aspect, the invention provides a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising: positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing; during the positioning of the portion of the

solid tubular liner that does not overlap with the wellbore casing within the wellbore proximate the porous subterranean zone, maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing; radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing proximate the porous subterranean zone.

Also according to the second aspect the invention provides a system for coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising: means for positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing; means for during the positioning of the portion of the solid tubular liner that does not overlap with the wellbore casing within the wellbore, maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing; means for radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and means for maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

Further according to the second aspect the invention provides apparatus for coupling a tubular liner to the wellbore casing, comprising a tubular support member defining a first internal passage; an expansion cone coupled to the tubular support member defining a second internal passage fluidicly coupled to the first internal passage; a tubular expansion cone launcher movably coupled to and mating with the expansion cone; a

tubular liner coupled to an end of the tubular expansion cone launcher; a shoe coupled to another end of the tubular expansion cone launcher including a valveable passage; means for during a positioning of a portion of the solid tubular liner that does not overlap with the wellbore casing within the wellbore, maintaining a longitudinal centre line of the expansion cone in a position that is substantially coincident with a longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing; and means for maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the solid tubular liner during a longitudinal displacement of the expansion cone relative to the tubular liner.

According to a third aspect, the invention provides a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising: positioning a solid tubular liner and an expansion cone within the wellbore; overlapping a portion of the solid tubular liner with the wellbore casing; radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing, applying substantially equal stresses to the interior surface of the portion of the solid tubular liner that does not overlap with the wellbore casing using the expansion cone proximate the porous subterranean zone.

Also according to the third aspect the invention provides a system for coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising: positioning a solid tubular liner and an expansion cone within the wellbore; overlapping a portion of the solid tubular liner with the wellbore casing; radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing proximate the porous subterranean zone, applying substantially equal stresses to the interior surface of the portion of the solid tubular liner that does not overlap with the wellbore casing using the expansion cone.

Further according to the third aspect the invention provides apparatus for coupling a tubular liner to the wellbore casing, comprising a tubular support member defining a first

internal passage; an expansion cone coupled to the tubular support member defining a second internal passage fluidicly coupled to the first internal passage; a tubular expansion cone launcher movably coupled to and mating with the expansion cone; a tubular liner coupled to an end of the tubular expansion cone launcher; and a shoe coupled to another end of the tubular expansion cone launcher including a valveable passage; and means for during a radial expansion of a portion of the solid tubular liner that does not overlap with the wellbore casing, applying substantially equal stresses to the interior surface of the portion of the solid tubular liner that does not overlap with the wellbore casing using the expansion cone.

According to a fourth aspect, the invention provides a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising: positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing, wherein the solid tubular liner includes a resilient helical standoff coupled to the exterior surface of the solid tubular liner; during the positioning of the solid tubular liner within the wellbore, the resilient helical standoff preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore; radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and the resilient helical standoff preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

Also according to the fourth aspect the invention provides a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising: positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing, wherein the solid tubular liner includes a plurality of spaced apart resilient standoffs coupled to the exterior surface of the solid tubular liner between the opposite ends of the solid tubular liner; during the positioning of the solid tubular liner within the wellbore, the resilient standoffs preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the

porous subterranean zone of the uncased section of the wellbore; radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and the resilient standoffs preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

According to a fifth aspect, the invention provides a method of coupling a tubular liner to the wellbore casing of the case section of the wellbore, comprising: determining that the uncased section traverses a porous subterranean zone; determining that the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone; positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing; during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore; radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

According to a sixth aspect, the invention provides a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising: determining that the uncased section traverses a porous subterranean zone; determining that the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone; if the uncased section is determined to traverse a porous subterranean zone having an operating pressure that is less than the operating pressure of the wellbore, then adding a passive structural means to the solid tubular liner; positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing; during the positioning of the solid tubular liner within the wellbore, the

passive structural means preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore; radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and the passive structural means preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

Brief Description of the Drawings

One embodiment of a method, system and apparatus in accordance with the invention will now be described by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a cross-sectional view illustrating a wellbore including a wellbore casing and an open hole section that traverses a porous subterranean layer.

FIG. 2 is a fragmentary cross-sectional view illustrating the introduction of an apparatus for casing the open hole section of the wellbore of FIG. 1.

FIG. 3 is a fragmentary cross-sectional view illustrating the injection of a fluidic material into the apparatus of FIG. 2.

FIG. 4 is a fragmentary cross-sectional view illustrating the placement of a plus into the exhaust passage of the shoe of the apparatus of FIG. 3.

FIG. 5 is a fragmentary cross-sectional view illustrating the pressurisation of the interior portion of the apparatus below the expansion cone of FIG. 4.

FIG. 6 is a fragmentary cross-sectional view illustrating the completion of the radial expansion of the tubular member of the apparatus of FIG. 5.

FIG. 7 is a fragmentary cross-sectional view illustrating the removal of the shoe from the apparatus of FIG. 6.

Detailed Description of the Illustrative Embodiments

An apparatus and method for casing an open hole section of a wellbore within a subterranean formation is provided. The apparatus and method provides a system for casing an open hole section of a wellbore within a subterranean formation in which a

tubular member having a plurality of radially oriented standoffs is radially expanded into contact with the preexisting wellbore casing and the open hole section. The standoffs provided on the exterior surface of the tubular member preferably position the tubular member away from the interior walls of the open hole section during the radial expansion process. In this manner, the tubular member does not adhere to underpressurised sections of the open hole section of the wellbore. In this manner, the process of radial expansion is more reliable.

Referring initially to Fig. 1, a wellbore 100 positioned within a subterranean formation 105 includes a preexisting casing 110 and an open hole section 115 that traverses an porous region 120. When the operating pressure within the wellbore P_{BORE} is greater than the operating pressure within the porous region P_{PORE}, fluidic materials will flow from the wellbore 100 into the porous region 120. As a result of the flow of fluidic materials from the wellbore 100 into the porous region 120, downhole equipment will tend to adhere to, or at least be drawn toward, the interior surface of the wellbore 100 in the vicinity of the porous region 120. This can have serious and adverse consequences when radially expanding a tubular member in such an operating environment.

Referring to Fig. 2, an apparatus 200 for forming a wellbore casing in the open hole section of the wellbore 100 may then be positioned within the wellbore in an overlapping relationship with the lower portion of the preexisting wellbore casing 110.

The apparatus 200 includes a tubular support member 205 having a longitudinal passage 210 and a transverse passage 215 that is coupled to an expansion cone 220 having a longitudinal passage 225 that is fluidicly coupled to the longitudinal passage 210. The expansion cone 220 is at least partially received within an expansion cone launcher 230 that includes a thin-walled annular member 235 and a shoe 240 having an exhaust passage 245. An expandable tubular member 250 extends from the expansion cone launcher 230 that includes a sealing member 255 and a plurality of standoffs 260a-260h affixed to the exterior surface of the expandable tubular member. In a preferred embodiment, the standoffs 260 are fabricated from a resilient material. A sealing cup 265 is attached to the exterior surface of the tubular support member 205 for preventing foreign materials from entering the interior of the expandable tubular member 250.

In a preferred embodiment, the apparatus 200 is provided as disclosed in one or

more of the following: (1) U.S. patent 6,328,113, (2) U.S. patent 6,497,289, (3) U.S. patent 6,823,937, (4) Australian patent application AU-A-16417/00, (5) U.S. patent 6,575,240, (6) U.S. patent 6,640,903, (7) U.S. patent 6,604,763, (8) U.S. patent 6,557,640, (9) International patent application WO 01/04535, (10) International patent application WO 01/60545, (11) U.S. patent 6,568,471, (12) U.S. patent application US-A-2003-0121558, (13) International patent application WO 01/33037, and (14) U.S. patent 6,695,012, the disclosures of which are incorporated herein by reference.

As illustrated in Fig. 2, during placement of the apparatus 200 within the wellbore 100, fluidic materials displaced by the apparatus 200 are conveyed through the longitudinal passages 210 and 225 to the transverse passage 215. In this manner, surge pressures during the placement of the apparatus 200 within the wellbore 100 are minimised. Furthermore, as illustrated in Fig. 2, the apparatus 200 is preferably initially positioned with upper portion of the tubular member 250 in opposing relation to the lower portion of the preexisting wellbore casing 110. In this manner, the upper portion of the tubular member 250 may be radially expanded into contact with the lower portion of the preexisting wellbore casing 110. In a preferred embodiment, during the placement of the apparatus 200 within the wellbore 100, the standoffs 260a-260h prevent the apparatus 200 from adhering to, or being drawn toward, the interior surface of the wellbore 100 in the vicinity of the porous region 120. In this manner, the apparatus 200 is approximately centred within the wellbore 100.

As illustrated in Fig. 3, the transverse passage 215 may then be closed and fluidic materials injected into the apparatus 200 through the longitudinal passage 210. In this manner, any blockages within any of the passages 210, 225, and 245 may be detected by monitoring the operating pressure whereby an increase in operating pressure above nominal, or predetermined, conditions may indicate a blockage of one of the passages.

As illustrated in Fig. 4, a plug 270 or other conventional stop member may then be introduced into the fluidic materials injected into the apparatus 200 through the passage 210, and the plug 270 may be positioned within the exhaust passage 245. In this manner, the exhaust passage 245 may be sealed off. Thus, continued injection of fluidic materials into the apparatus 200 through the passage 210 may thereby pressurise a region 275 below the expansion cone 220.

As illustrated in Figs. 5 and 6, continued pressurisation of the region 275 causes the expansion cone 220 to radially expand the expandable tubular member 250 off of the expansion cone. In this manner, the upper portion of the radially expanded tubular member 250 is coupled to the lower portion of the preexisting wellbore casing 110. In a preferred embodiment, during the radial expansion process, the tubular support member 205 is raised out of the wellbore 100.

In a preferred embodiment, throughout the radial expansion process, the standoffs 260a-260h prevent the exterior surface of the apparatus 200 from adhering to, or being drawn toward, the interior surface of the wellbore 100 in the vicinity of the porous region 120. In this manner, the apparatus 200 is preferably substantially centred within the wellbore 100. Furthermore, in this manner, the longitudinal centre axis of the expansion cone 220 is preferably maintained in a position that is substantially coincident with the longitudinal centre axis of the tubular member 250. In addition, in this manner, the stresses applied to the interior surface of the tubular member 250 by the axial displacement of the expansion cone 220 are substantially even. Finally, in this manner, overstressing of the tubular member 250 is prevented thereby eliminating catastrophic failure of the tubular member 250.

As illustrated in Fig. 7, the shoe 240 may then be removed using a conventional milling device.

In a preferred embodiment, upon radially expanding the expandable tubular member 250, the standoffs 260a-260h seal and isolate intervals within the open hole section 115. In several alternative embodiments, the standoffs 260 may be provided, for example, by annular members spaced along the length of the expandable tubular member 250 and/or a continuous member that is wrapped around the expandable tubular member 250 in helical fashion.

It is understood that variations may be made in the foregoing without departing from the scope of the invention. For example, the apparatus 200 may be used to form and/or repair, for example, a wellbore casing, a pipeline, or a structural support.

Although illustrative embodiments of the invention have been shown and described, a wide range of modification, changes and substitution is contemplated in the foregoing disclosure. In some instances, some features of the present invention may be

2001283026 21 Dec 2005

employed without a corresponding use of the other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that that prior art forms part of the common general knowledge in Australia.

2001283026 21 Dec 2005

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. In a wellbore that traverses a subterranean formation and includes a cased section having a wellbore casing and an uncased section that traverses a porous subterranean zone, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising:

positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing;

during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore;

radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and

preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

2. The method of claim 1, further comprising:

during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the uncased section of the wellbore; and

preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

3. In a wellbore that traverses a subterranean formation, the wellbore including a

cased section having a wellbore casing and an uncased section that traverses a porous subterranean zone, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising:

positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing;

during the positioning of the portion of the solid tubular liner that does not overlap with the wellbore casing within the wellbore proximate the porous subterranean zone, maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing;

radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and

maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing proximate the porous subterranean zone.

4. In a wellbore that traverses a subterranean formation, the wellbore including a cased section having a wellbore casing and an uncased section that traverses a porous subterranean zone, wherein the operating pressure of the wellbore is greater than the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising:

positioning a solid tubular liner and an expansion cone within the wellbore;

overlapping a portion of the solid tubular liner with the wellbore casing;

radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and

during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing, applying substantially equal stresses to the interior surface of the portion of the solid tubular liner that does not overlap with the wellbore casing using the expansion cone proximate the porous subterranean zone.

5. In a wellbore that traverses a subterranean formation and includes a cased section having a wellbore casing and an uncased section that traverses a porous subterranean zone, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, a system for coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising:

means for positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing;

means for during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore;

means for radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and

means for preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

6. The system of claim 5, further comprising:

means for during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the uncased section of the wellbore; and

means for preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the uncased

2001283026 21 Dec 2005

section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

7. In a wellbore that traverses a subterranean formation, the wellbore including a cased section having a wellbore casing and an uncased section that traverses a porous subterranean zone, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, a system for coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising:

means for positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing;

means for during the positioning of the portion of the solid tubular liner that does not overlap with the wellbore casing within the wellbore, maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing;

means for radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and

means for maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

8. In a wellbore that traverses a subterranean formation, the wellbore including a cased section having a wellbore casing and an uncased section that traverses a porous subterranean zone, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, a system for coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising:

positioning a solid tubular liner and an expansion cone within the wellbore;

overlapping a portion of the solid tubular liner with the wellbore casing;

radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and

during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing proximate the porous subterranean zone, applying substantially equal stresses to the interior surface of the portion of the solid tubular liner that does not overlap with the wellbore casing using the expansion cone.

9. An apparatus for coupling a tubular liner to a wellbore casing within a wellbore that traverses a porous subterranean formation, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, comprising:

a tubular support member defining a first internal passage;

an expansion cone coupled to the tubular support member defining a second internal passage fluidicly coupled to the first internal passage;

a tubular expansion cone launcher movably coupled to and mating with the expansion cone;

a solid tubular liner coupled to an end of the tubular expansion cone launcher; and

a shoe coupled to another end of the tubular expansion cone launcher including a valveable passage;

means for during a positioning of the solid tubular liner within the wellbore, preventing a portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the wellbore; and

means for preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the wellbore during a radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

10. The apparatus of claim 9, further comprising:

means for during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing

from adhering to the porous subterranean zone of the wellbore; and

means for preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from adhering to the porous subterranean zone of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

11. An apparatus for coupling a tubular liner to a wellbore casing within a wellbore that traverses a porous subterranean formation, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, comprising:

a tubular support member defining a first internal passage;

an expansion cone coupled to the tubular support member defining a second internal passage fluidicly coupled to the first internal passage;

a tubular expansion cone launcher movably coupled to and mating with the expansion cone;

a tubular liner coupled to an end of the tubular expansion cone launcher;

a shoe coupled to another end of the tubular expansion cone launcher including a valveable passage;

means for during a positioning of a portion of the solid tubular liner that does not overlap with the wellbore casing within the wellbore, maintaining a longitudinal centre line of the expansion cone in a position that is substantially coincident with a longitudinal centre line of the portion of the solid tubular liner that does not overlap with the wellbore casing; and

means for maintaining the longitudinal centre line of the expansion cone in a position that is substantially coincident with the longitudinal centre line of the solid tubular liner during a longitudinal displacement of the expansion cone relative to the tubular liner.

12. An apparatus for coupling a tubular liner to a wellbore casing within a wellbore that traverses a porous subterranean formation, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone,

comprising:

a tubular support member defining a first internal passage;

an expansion cone coupled to the tubular support member defining a second internal passage fluidicly coupled to the first internal passage;

a tubular expansion cone launcher movably coupled to and mating with the expansion cone;

a tubular liner coupled to an end of the tubular expansion cone launcher; and

a shoe coupled to another end of the tubular expansion cone launcher including a valveable passage; and

means for during a radial expansion of a portion of the solid tubular liner that does not overlap with the wellbore casing, applying substantially equal stresses to the interior surface of the portion of the solid tubular liner that does not overlap with the wellbore casing using the expansion cone.

13. In a wellbore that traverses a subterranean formation and includes a cased section having a wellbore casing and an uncased section that traverses a porous subterranean zone, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising:

positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing, wherein the solid tubular liner includes a resilient helical standoff coupled to the exterior surface of the solid tubular liner;

during the positioning of the solid tubular liner within the wellbore, the resilient helical standoff preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore;

radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner;

and the resilient helical standoff preventing the portion of the solid tubular liner that does

not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

14. In a wellbore that traverses a subterranean formation and includes a cased section having a wellbore casing and an uncased section that traverses a porous subterranean zone, wherein the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone, a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising:

positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing, wherein the solid tubular liner includes a plurality of spaced apart resilient standoffs coupled to the exterior surface of the solid tubular liner between the opposite ends of the solid tubular liner;

during the positioning of the solid tubular liner within the wellbore, the resilient standoffs preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore;

radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and

the resilient standoffs preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

15. In a wellbore that traverses a subterranean formation, the wellbore including a cased section having a wellbore casing and an uncased section, a method of coupling a tubular liner to the wellbore casing of the case section of the wellbore, comprising:

determining that the uncased section traverses a porous subterranean zone;

determining that the operating pressure of the wellbore is greater than the operating

pressure of the porous subterranean zone;

positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing;

during the positioning of the solid tubular liner within the wellbore, preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore;

radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion cone relative to the solid tubular liner; and

preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

16. In a wellbore that traverses a subterranean formation, the wellbore including a cased section having a wellbore casing and an uncased section, a method of coupling a tubular liner to the wellbore casing of the cased section of the wellbore, comprising:

determining that the uncased section traverses a porous subterranean zone;

determining that the operating pressure of the wellbore is greater than the operating pressure of the porous subterranean zone;

if the uncased section is determined to traverse a porous subterranean zone having an operating pressure that is less than the operating pressure of the wellbore, then adding a passive structural means to the solid tubular liner;

positioning a solid tubular liner and an expansion cone within the wellbore with the solid tubular liner overlapping the wellbore casing;

during the positioning of the solid tubular liner within the wellbore, the passive structural means preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore;

radially expanding the solid tubular liner by injecting a fluidic material into the tubular liner to pressurise the interior of the solid tubular liner and displace the expansion

cone relative to the solid tubular liner; and

the passive structural means preventing the portion of the solid tubular liner that does not overlap with the wellbore casing from contacting the porous subterranean zone of the uncased section of the wellbore during the radial expansion of the portion of the solid tubular liner that does not overlap with the wellbore casing.

17. A method of coupling a tubular liner to the wellbore casing of a cased section of a wellbore, substantially as herein described with reference to the accompanying drawings.

18. A system for coupling a tubular liner to the wellbore casing of a cased section of a wellbore, substantially as herein described with reference to the accompanying drawings.

19. Apparatus for coupling a tubular liner to a wellbore casing within a wellbore, substantially as herein described with reference to the accompanying drawings.

Dated this 20th day of December, 2005
Enventure Global Technology
by their Patent Attorneys
DAVIES COLLISON CAVE

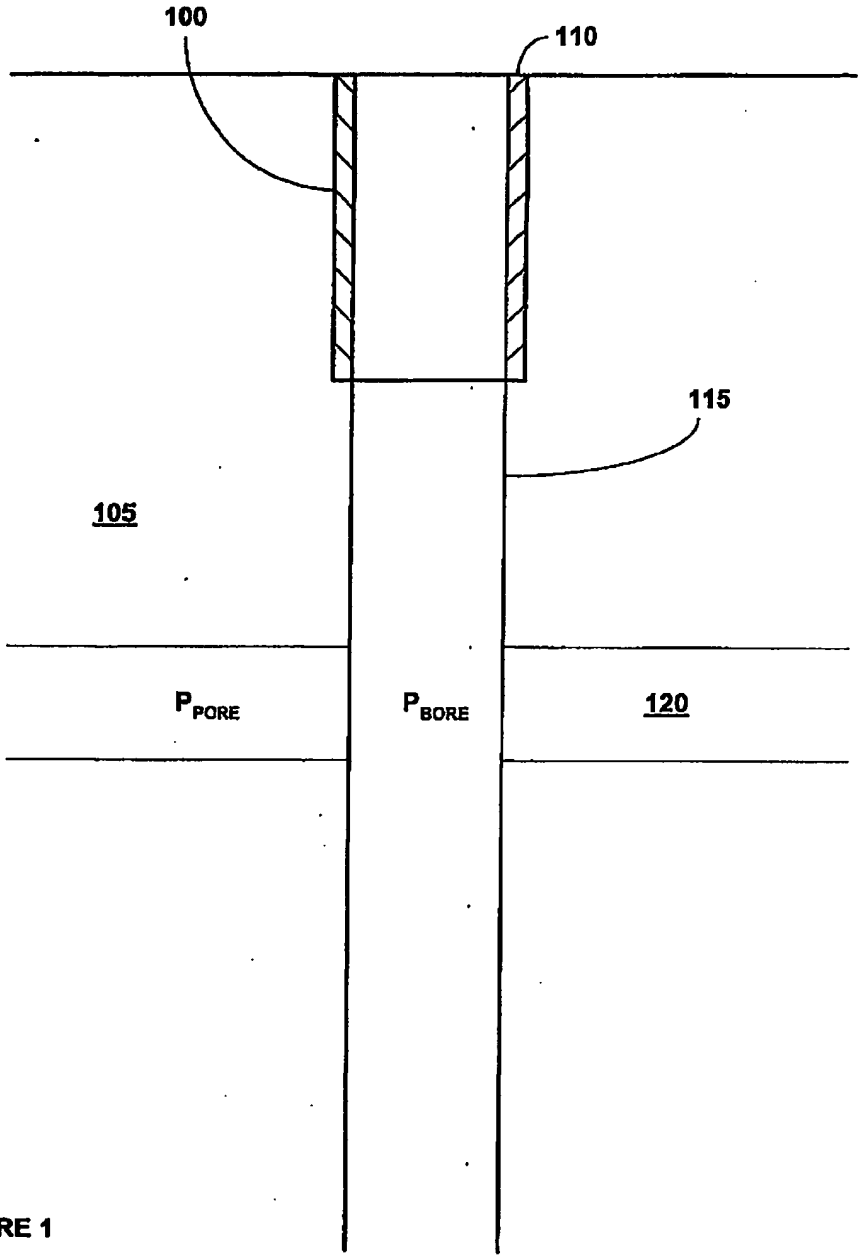

FIGURE 1

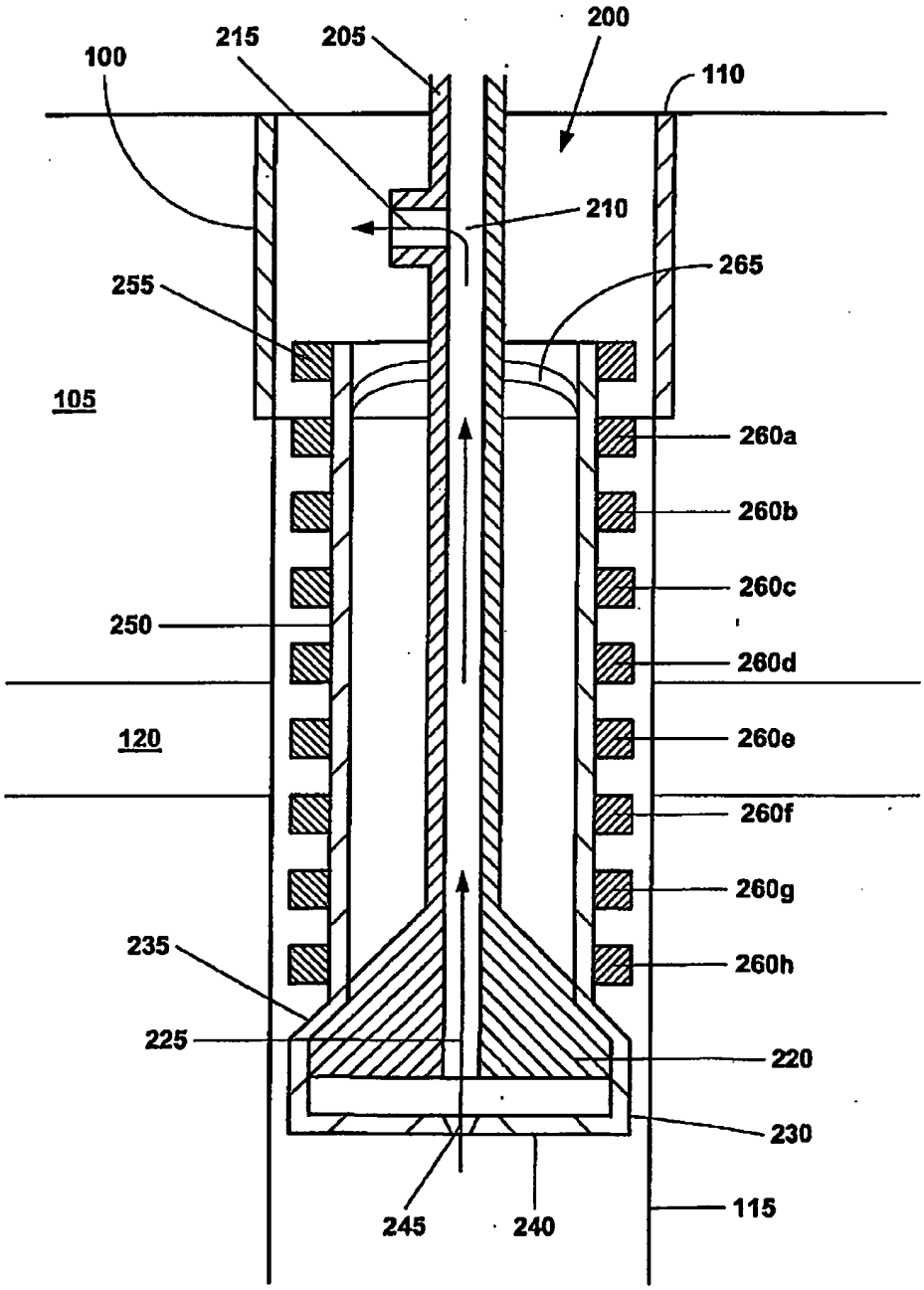
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FIGURE 2

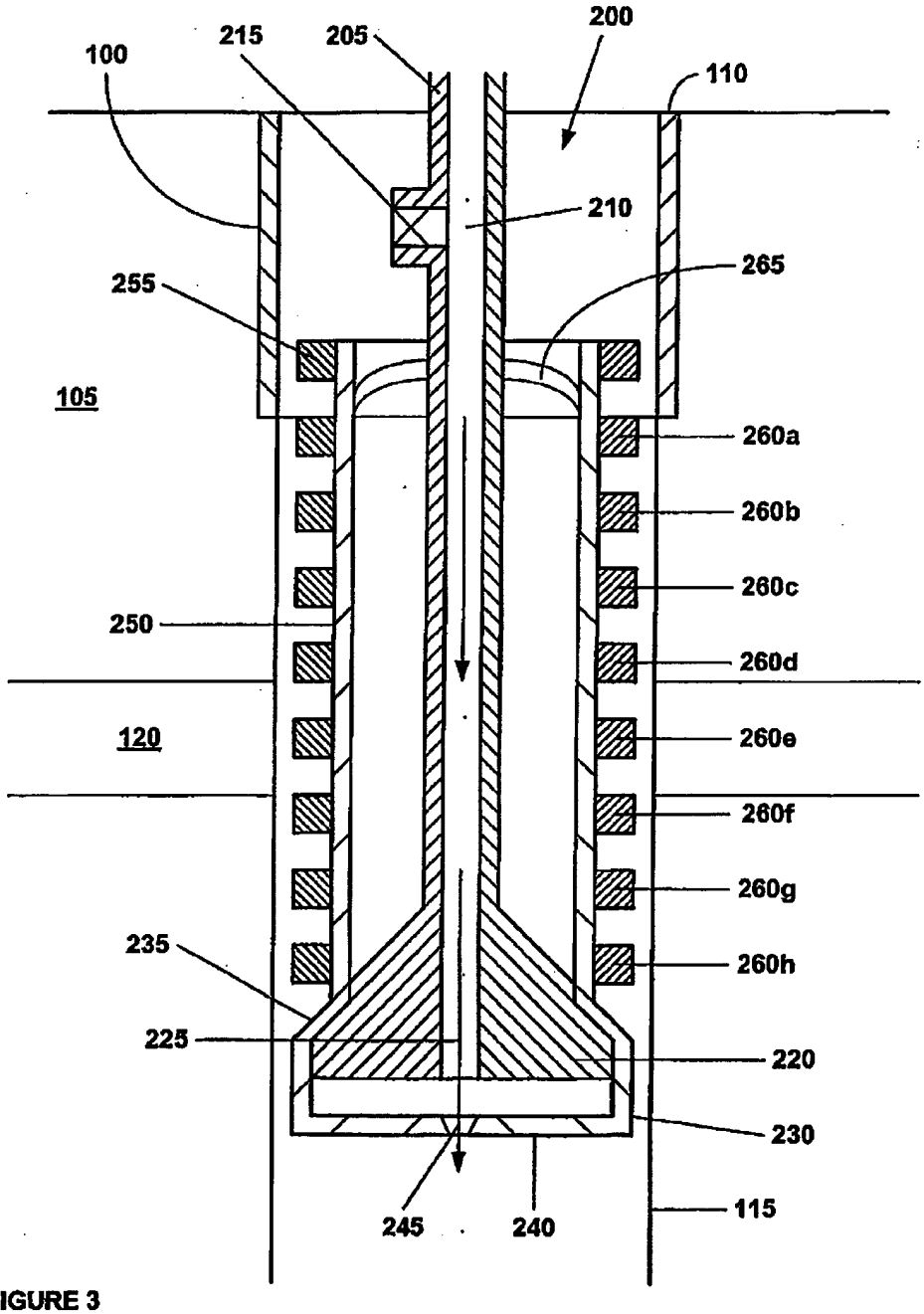
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FIGURE 3

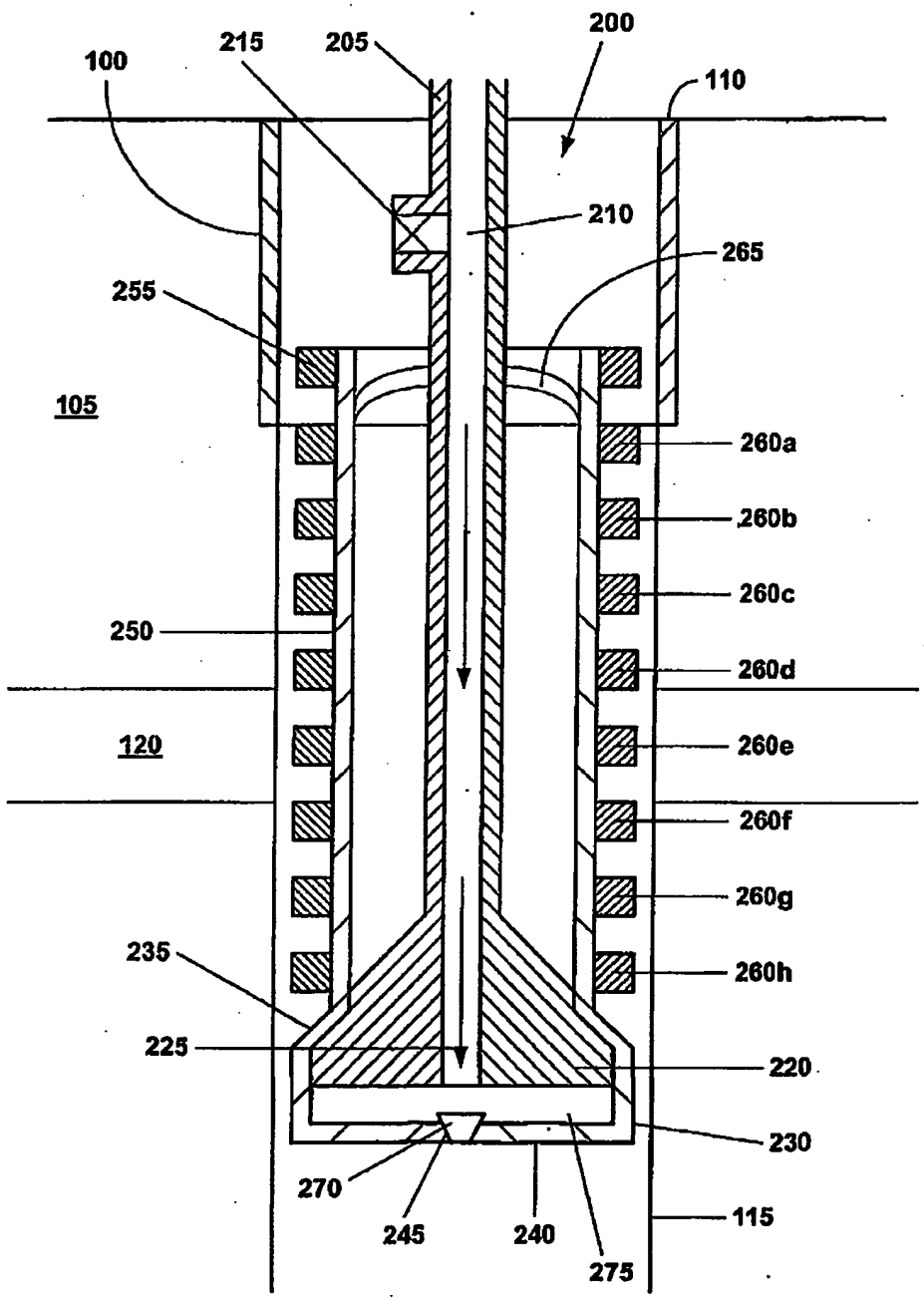
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FIGURE 4

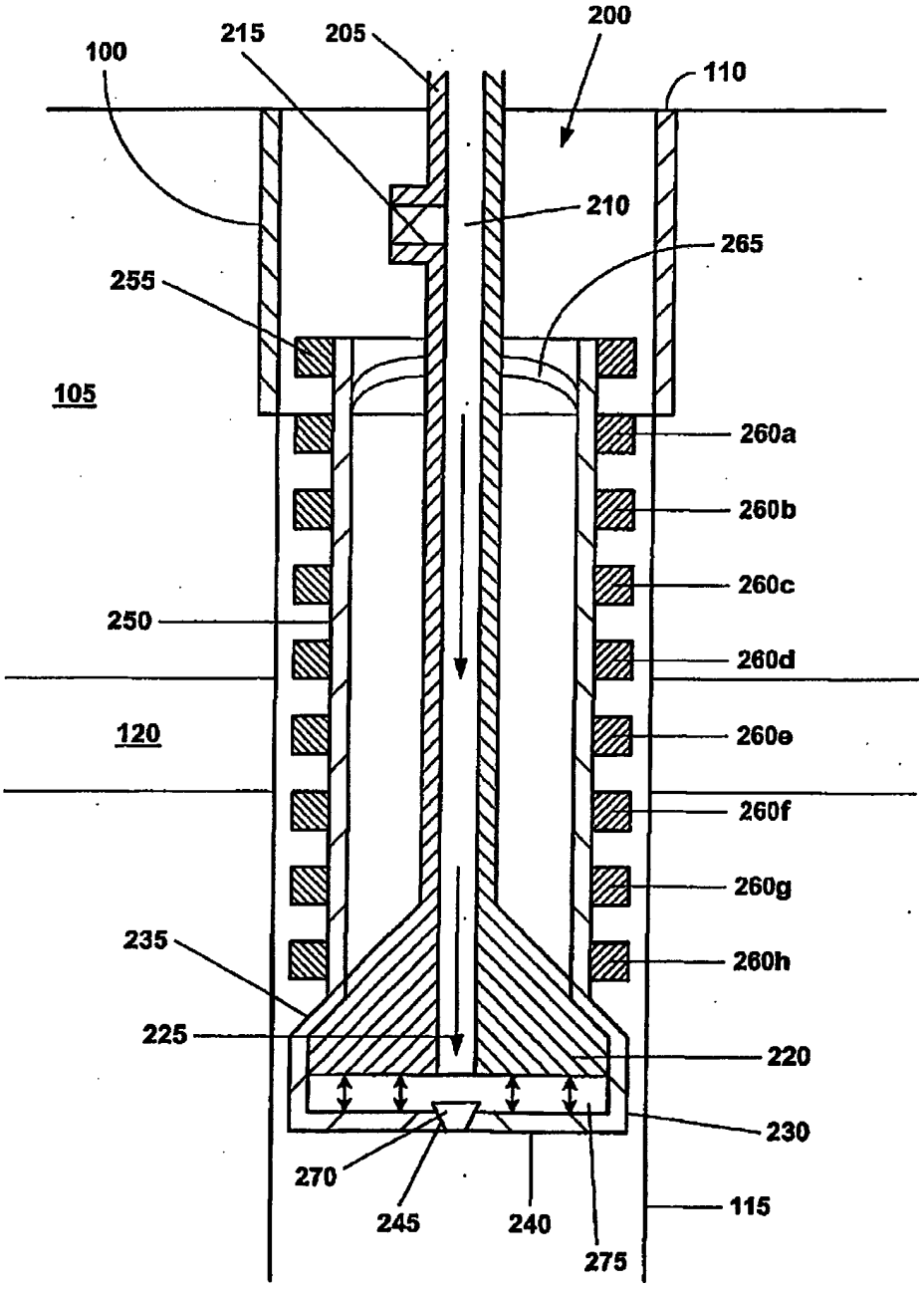
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FIGURE 5

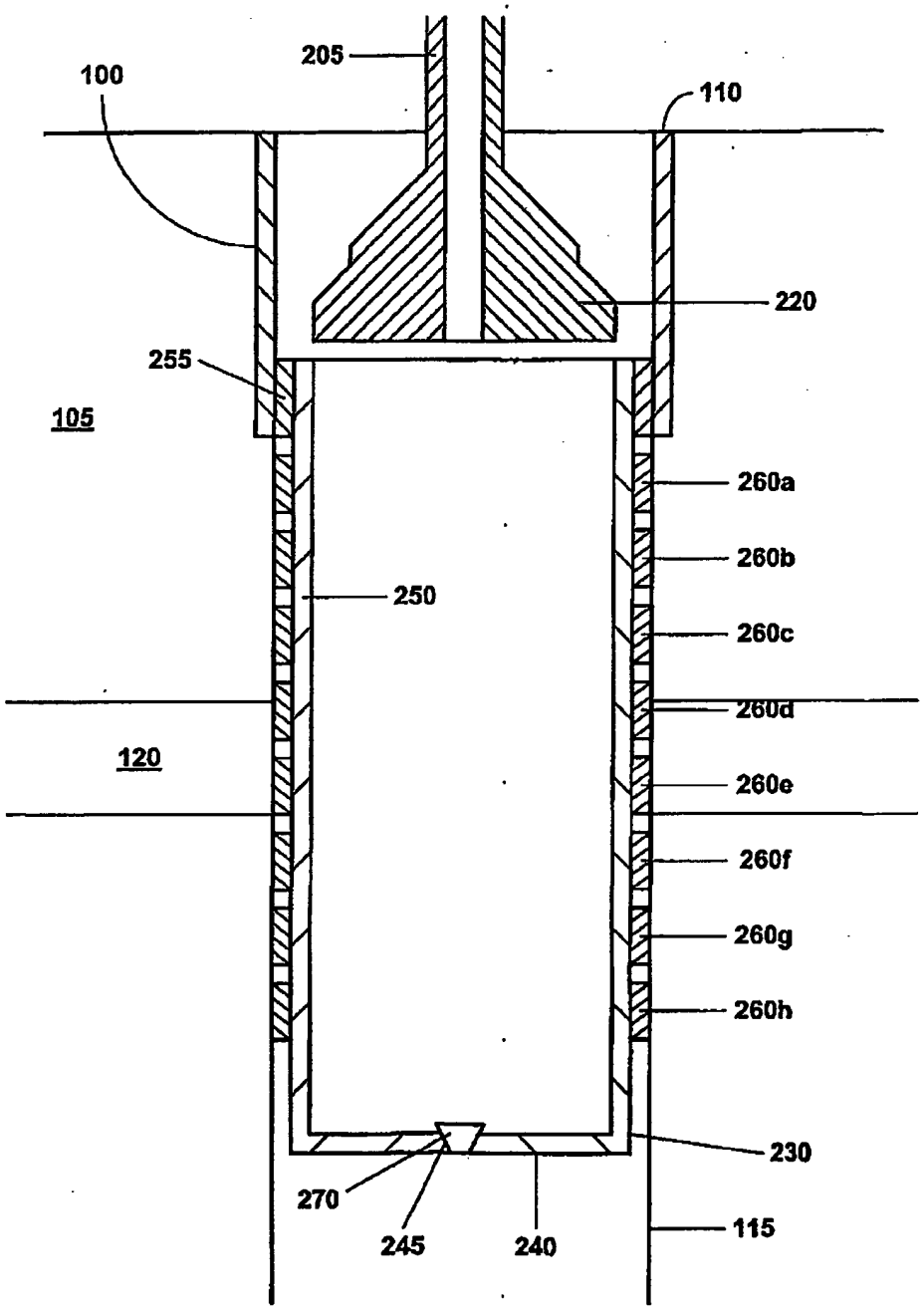
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FIGURE 6

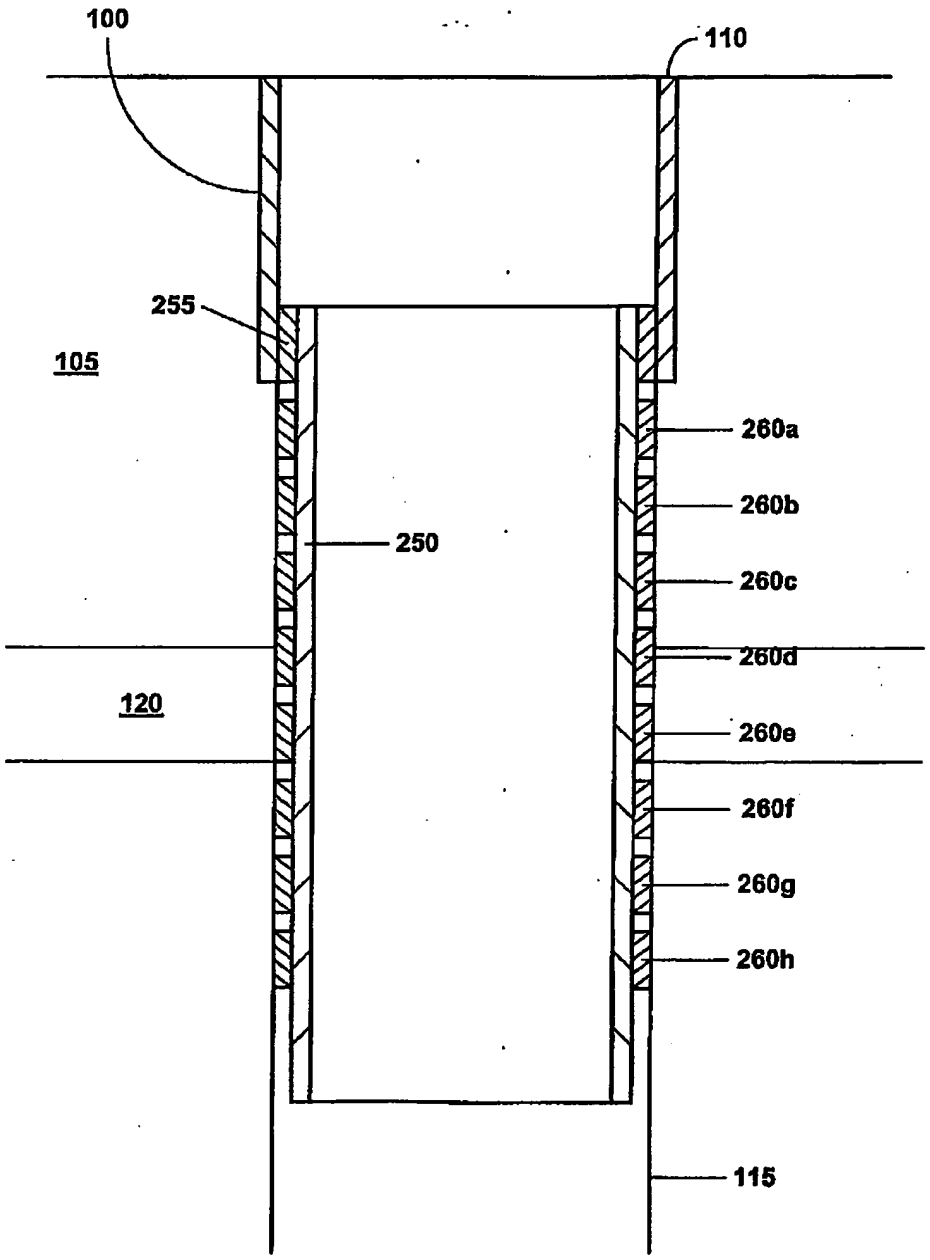
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FIGURE 7